SPRING LAKE 2017

Lake Stewardship Monitoring Report

King County Water & Land Resources Division
Science & Technical Support Section
www.kingcounty.gov/EnvironmentalScience

Summary & Recommendations

Thank you to Caren Adams, Valerie Weber, & Tom Rohrer, the volunteer monitors for Spring Lake.

The key takeaways from the 2017 monitoring season are:

- In 2017, Spring Lake had moderate nutrient concentrations and fairly high algal growth, with less-clear water.
- Nitrogen-to-phosphorus (N:P) ratios were below 25 for much of the monitoring season. This indicates the potential for algal blooms to be dominated by cyanobacteria (which have the ability to produce toxins).
- Spring Lake had long-term trends of increasing phosphorus concentrations and shallower Secchi depths.
- No algal blooms were reported for toxin testing in 2017.

The Lake Stewardship Program recommends:

- Explore why phosphorus concentrations have been increasing over time. If this increase continues, it could lead to more algal blooms in the future.
- Stay alert for toxic algae blooms in Spring Lake – increase people's awareness of toxic algae, and their ability to identify which algae are potentially toxic. Any potentially toxic blooms should be reported to the King County Lake Stewardship Program and sampled for toxin analysis.
- Monitoring is a key part of good lake stewardship, building a valuable long-term dataset to guide lake management and detect any future problems. Continue to monitor Spring Lake through the Lake Stewardship Program.

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What We Measure & Why

- **Secchi depth** is a measure of water clarity or transparency. Secchi depth is shallower when there are more suspended particles in the lake, such as sediment or algae. Secchi depth is also affected by water color, often from tannins or other naturally occurring organic molecules.

- **Water temperature** can affect the growth rates of plants and algae. In addition, cooler or warmer water temperatures favor different species of fish and other aquatic organisms.

- **Chlorophyll-a** is a measure of the amount of algae in a lake. Chlorophyll-a is a pigment necessary for algae to photosynthesize and store energy.

- **Phosphorus** and **nitrogen** are naturally occurring nutrients necessary for growth and reproduction in both plants and animals. Increases in nutrients (especially phosphorus) can lead to more frequent and dense algal blooms.

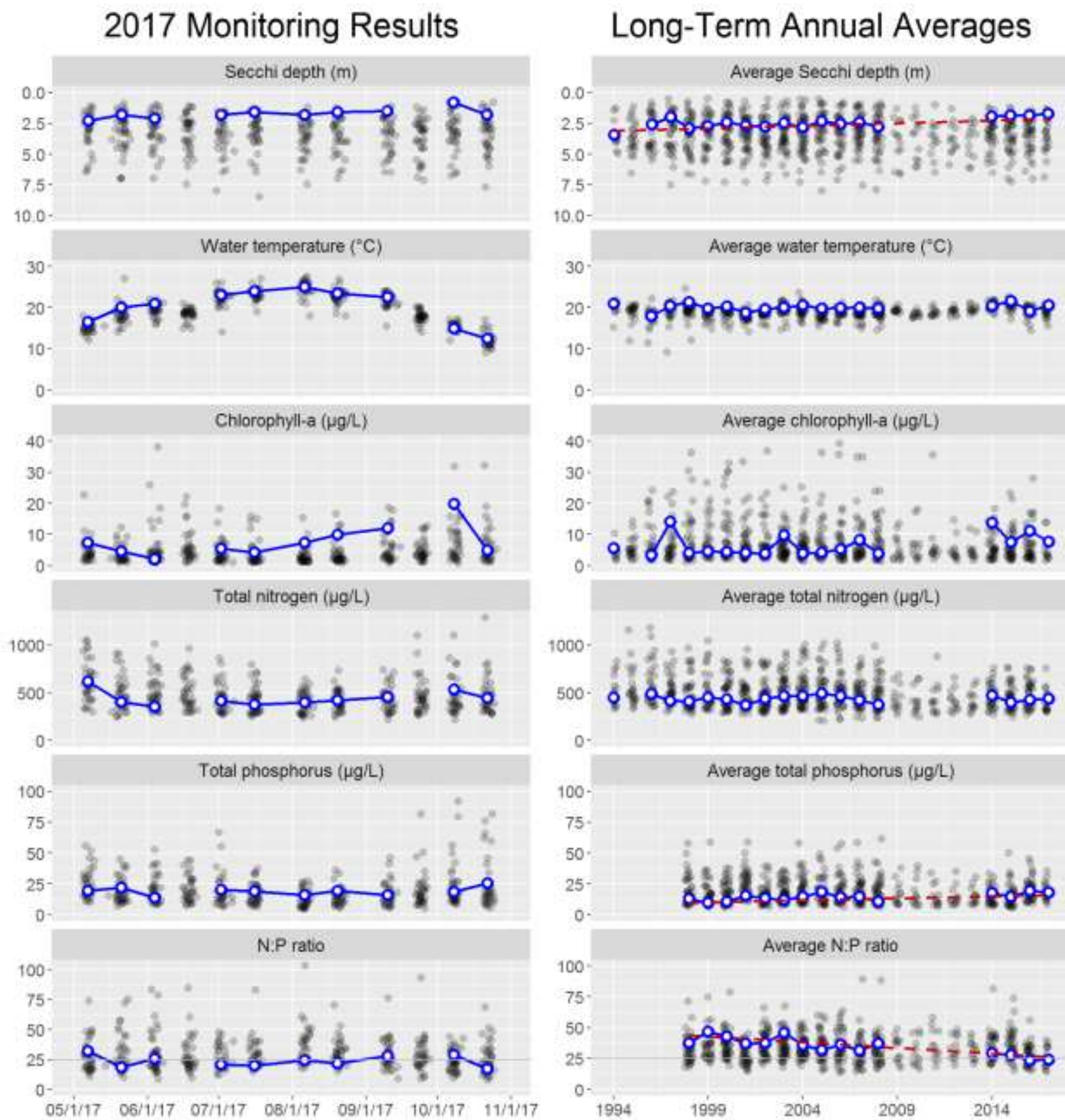
- The **ratio of total nitrogen to total phosphorus (N:P)** indicates whether nutrient conditions favor the growth of cyanobacteria (blue-green algae). When N:P ratios are near or below 25, cyanobacteria can dominate the algal community. This is important because cyanobacteria have the ability to produce toxins.

Water Quality Results & Trends

The following graphs show the water-quality parameters that are sampled from May through October, at 1 m depth (additional depths and parameters are measured on profile days; see *Supplemental Data*). The left column of graphs shows results for each sampling date in 2017, and the right column shows average values for each year (May-October averages).

Data for Spring Lake are the blue circles (with white centers) connected by the blue line. Any gaps in the blue line indicate missed samples. To provide some context for these values, the grey points in the background are results for all other lakes in the Lake Stewardship program.

Any long-term trends in Spring Lake are drawn with a dashed red line and described further after the graphs. Statistical trend analyses used a seasonal (monthly) Kendall test ($p<0.05$).



Nitrogen-to-phosphorus (N:P) ratios were below 25 for much of the monitoring season. This indicates the potential for algal blooms to be dominated by cyanobacteria (which have the ability to produce toxins).

The table below gives more details about the long-term trends. Results are presented as an average amount and percent of change per decade (the increase or decrease over ten years). Percent change is calculated as the percent of the estimated value in 1994, when monitoring started.

Parameter	Change per Decade	(%)
Secchi depth	-0.42 m	(-13%)
Total phosphorus	3.2 µg/L	(38%)
N:P ratio	-9.3	(-20%)

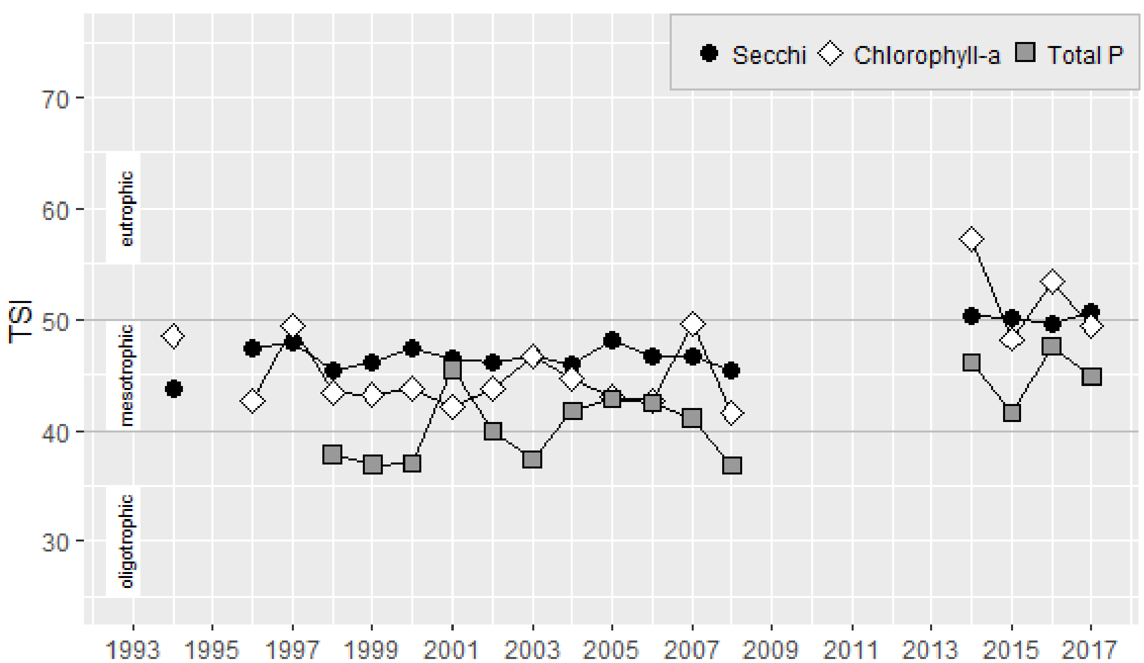
Trophic State

The Trophic State Index (TSI) is a common index of a lake's overall biological productivity. TSI values are calculated from Secchi depth, chlorophyll-a concentrations, and total phosphorus concentrations. These three TSI estimates are all scaled between 0 and 100.

TSI calculations use average values from June-September, focusing on fairly consistent "summer" conditions. Note that previous Lake Stewardship reports (through 2016) included May and October data as well. The TSI values presented below, for all years, have been recalculated using only June-September data.

Oligotrophic lakes (TSI <40) are very clear, with low nutrient concentrations and low algal growth. *Eutrophic* lakes (TSI >50) have less-clear water, with high nutrient concentrations and high algal growth. Eutrophic lakes are more likely to have frequent algal blooms. *Mesotrophic* lakes (TSI 40-50) are in the middle, with fairly clear water, and moderate nutrient concentrations and algal growth. Lakes in lowland King County have a range of different natural trophic states, and human activities may also alter a lake's trophic state (usually by changing nutrient inputs).

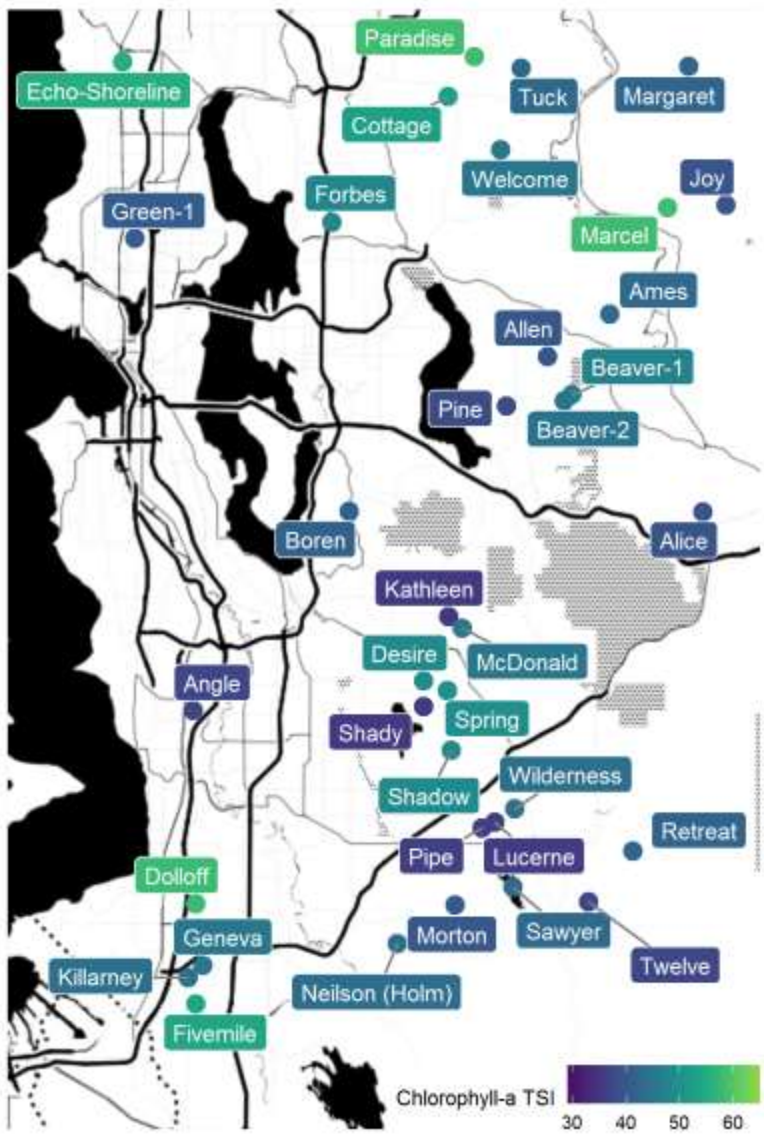
Trophic state indices



Spring Lake was not monitored in 2009-2013, when budget cuts reduced monitoring for many lakes in unincorporated King County. During that data gap, water quality appears to have changed. All three TSI values were noticeably higher in 2014-2017 than they had been in 1994-2008. The three TSI values in recent years have been around the mesotrophic-eutrophic boundary.

Comparison map

For a comparison with other lakes, this map shows the trophic state for each lake in the King County Lake Stewardship program in 2017. The color of each circle indicates the lake's average chlorophyll-a TSI value for the year.



Supplemental Data

Summary statistics

This table summarizes data from May-October 2017 (1 m depth only), giving the minimum, mean (average), and maximum values for each parameter. To reduce biases from missing data or changes in sampling frequency, monthly means were calculated and then averaged to give an overall mean.

Parameter	Minimum	Mean	Maximum
Secchi depth (m)	0.8	1.7	2.3
Water temperature (°C)	12.5	20.5	25.0
Chlorophyll-a (µg/L)	2.1	7.6	19.8
Total nitrogen (µg/L)	353.0	436.1	620.0
Total phosphorus (µg/L)	13.8	18.3	25.5
N:P ratio	17.3	24.3	32.0

Water column profile

In May and August, water was collected at the mid-lake sampling station from three depths in a water-column profile: 1 m, the middle depth of the water column, and 1 m from the lake bottom.

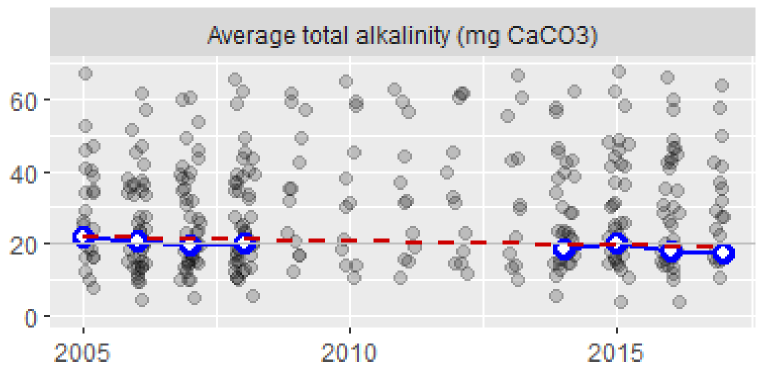
Date	Depth	Temp	Chlor	Pheo	TN	NH3	NO2/3	TP	OPO4
5/21/2017	1	20.0	4.5	(1.4)	406	4.3	53.6	22.1	1.2
	4	11.0	20.7	3.2	701	–	–	20.2	–
	8	8.0	–	–	613	8.6	325.0	26.2	3.2
8/20/2017	1	23.5	9.8	3.3	421	6.4	(10.0)	19.4	1.0
	4	12.5	(1.0)	2.6	316	–	–	38.5	–
	8	8.5	–	–	972	630.0	(10.0)	348.0	28.3

* Parameter abbreviations are: chlorophyll-a (Chlor), pheophytin (Pheo), total nitrogen (TN), ammonia (NH3), nitrate/nitrite (NO2/3), total phosphorus (TP), orthophosphate (OPO4). Depth is in m, temperature is in °C, and all other parameters are in µg/L. Dashes indicate parameters that were not analyzed for a given sample. Values below the method detection limit (MDL) are enclosed in parentheses and have the value of the MDL substituted.

Total alkalinity

A lake's ability to resist acidification, also called its buffering capacity, is measured as "total alkalinity." Lakes with total alkalinity less than 20 mg $CaCO_3$ are considered sensitive to acidification. We measured total alkalinity in May and August (on profile-sampling days) at 1 m depth. In 2017, the average total alkalinity of these two samples was 17.3 mg $CaCO_3$.

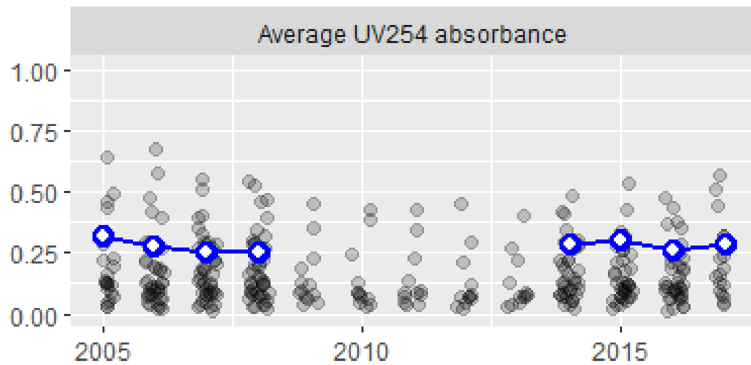
The blue circles (with white centers) and blue line are annual average alkalinity values for Spring Lake. Grey points in the background are results for all other lakes in the Lake Stewardship program. The dashed red line shows the long-term trend in alkalinity, with an average change of -2.4 mg $CaCO_3$ per decade.



Water color

Water color affects a lake's water clarity (and Secchi depth). Water color is measured by shining a specific wavelength of ultraviolet light (254 nm) through a filtered water sample and measuring the percent that was absorbed. We measured UV254 absorbance in May and August (on profile-sampling days) at 1 m depth. In 2017, the average UV254 absorbance of these two samples was 0.29, on a scale where 0 is no absorbance (perfectly clear) and 1 is complete absorbance (perfectly opaque).

The blue circles (with white centers) and blue line are annual average UV absorbance values for Spring Lake. Grey points in the background are results for all other lakes in the Lake Stewardship program.



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